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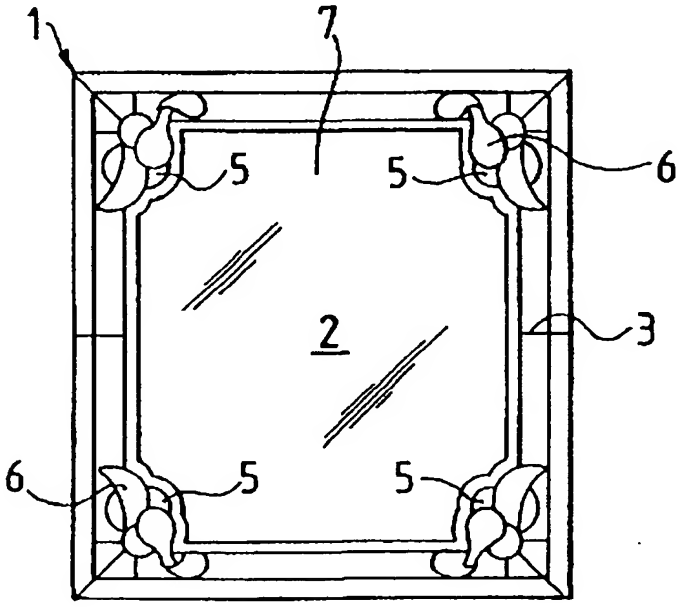
(54) Title: DECORATIVE WINDOW AND MIRROR AND METHOD OF MANUFACTURING THE SAME



(57) Abstract: A decorative window and/or mirror comprises a toughened glass sheet having on one surface one or more areas a pattern or patterns which may be coloured. A sheet of resin material formed with a decorative pattern is bonded to the glass sheet. If the pattern is coloured, the areas of colour are positioned above those sections of the resin which are to appear coloured in the window or mirror.

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DECORATIVE WINDOW AND MIRROR AND METHOD OF MANUFACTURING THE SAME

The present invention relates to decorative windows and mirrors and to methods of manufacturing the same. More especially, but not exclusively the invention relates to such windows and mirrors having decorative patterns which may be at least partially coloured.

Traditionally, decorative windows and mirrors have been fabricated by grinding contours into suitably dimensioned plate glass. Once contoured, the glass is polished to produce the required finish. Windows and mirrors produced in this way are relatively expensive because of the time and skilled labour employed in their manufacture. Decorative windows and mirrors have also been made as composites by adhering or otherwise securing a decorative pane or border to one or more glass sheets. The main disadvantage of windows and mirrors manufactured in this manner is again the relatively high cost incurred during manufacture.

Recent advances produced windows and mirrors that may be mass produced less expensively than traditional methods. For example, windows and mirrors with decorative designs and surfaces have been produced by injection moulding techniques using clear thermoplastic materials. However, if various sizes, shapes, and patterns of windows are desired, then such techniques become expensive due to the high cost of the tooling. Limited production runs are also cost prohibitive because a new die must be used for each of the different sizes and designs. Additionally, such windows have not met with commercial success because they do not look and feel like glass.

UK Patent Application 2338681A discloses a method of producing a decorative window which overcomes many of the problems discussed above. In this process a glass master containing a decorative pattern is used to fabricate a mould with a complementary

pattern. The mould is then oriented against a glass sheet having a release material facing the mould cavity. Hard casting resin is introduced into the cavity and cured. The decorative resin sheet can easily be removed from the mould and used to fabricate a window. The resin sheet can be cut to a desired size and shape. The cured decorative resin sheet is typically laminated to a glass sheet using a soft resin thus forming a decorative window. A second glass sheet may be attached to the decorative window in such a way as to house the resin sheet thus forming a window having an exterior consisting entirely of glass.

In many respects the present invention replicates the manufacturing process disclosed in GB-A-2338681. Modifications do, however, need to be made to the process disclosed particularly to ensure that the unpatterned area of the window or mirror remains at all times free of the resin which is used for producing the decorative pattern. These modifications are the subject of this invention and do provide a process by which windows and mirrors with decorative patterns can be produced relatively cheaply and with sufficient flexibility to enable a wide variety of aesthetically pleasing designs to be produced.

In one aspect, the invention provides a method of producing a window or mirror having a decorative pattern wherein resin is cast into a cavity defined between an annealed glass sheet and a flexible mould which replicates the shape, dimensions and design of the required pattern, the moulding having upstanding gaskets which are positioned alongside such margin of the pattern and cooperate with the glass sheet to confine cast resin to the pattern area defined between the gaskets.

The introduction of colours into decorative windows and mirrors has proved to be both difficult to achieve and expensive to produce. In many instances, this has previously been achieved by colouring discrete sections of the glass before or after curing, or by adhering coloured shapes to the finished window or mirror.

In another aspect, the present invention sets out to provide a decorative and at least partially coloured window and/or mirror which can be produced relatively cheaply and with sufficient flexibility to enable a wide variety of aesthetically pleasing patterns and

designs to be produced.

According to the present invention in this other aspect, there is provided a decorative window or mirror which comprises a toughened glass sheet having on one surface one or more areas of colour and to which is bonded one or more sheets formed with a decorative pattern and produced from a cast resin, the or each area of colour overlying the or each sheet.

The areas of colour may be printed by silk screening one or more coloured inks onto the glass surface. Alternatively, the areas of colour comprise coloured films applied to a surface or surfaces of the glass sheet. Alternatively, the areas of colour are applied to the glass sheet by a hand-painting or spraying technique.

The cast resin may be transparent. Alternatively, the resin may be tinted or coloured. Typically the resin is an acrylic.

In a further aspect, the invention provides a method of producing a window or mirror having a decorative pattern formed by casting liquid resin into a cavity defined between a toughened glass sheet whose surface has applied to it an area of colour, and a flexible mould which replicates the shape, dimensions and design of the required pattern, the mould having one or more upstanding gaskets which are positioned alongside the margin of the pattern to be formed and cooperate with the glass sheet to confine cast resin to the pattern area defined between the gasket(s), the coloured area of the glass surface being positioned below the area confined by the mould.

The flexible mould may be produced by pouring a mixture of a silicone and a catalyst onto the surface of a substrate formed with a decorative design which is in the inverse of the decorative pattern to be bonded to the mirror surface and bordered by grooves which extend around the entire periphery of the decorative pattern, the mixture of silicone and catalyst being exposed to a vacuum before pouring to remove trapped air therefrom.

A release agent may be applied to the substrate surface before pouring of the silicone and catalyst mix.

A web may be placed on the surface of a first poured quantity of silicone and catalyst mix, the web being subsequently covered by a second pouring of the mix.

The method may comprise the further steps of releasing the mould from the substrate, inverting the mould, clamping to the upper surface of the mould a toughened glass sheet to which the pattern is to be bonded with the now upstanding ridge formed by the grooves of the substrate compressed to define the gasket(s) to prevent the outflow of liquid from the mould interior, casting into the mould interior liquid resin, and after curing of the resin, removing the flexible mould from the glass surface.

Means may be provided in communication with the mould interior to release any trapped air therefrom.

The liquid resin may be cured by exposing the assembly of the glass sheet and the mould to infra-red heat.

In a still further aspect, the invention provides a method of producing a mirror having a decorative border formed by casting liquid resin into a cavity defined between an annealed glass sheet and a flexible mould which replicates the shape, dimensions and design of the required border, the mould having one or more upstanding gaskets which are positioned alongside the margin of the border to be formed and cooperate with the glass sheet to confine cast resin to the border area defined between the gasket(s).

The flexible mould may be produced by pouring a mixture of silicone and a catalyst onto the surface of a substrate formed with a decorative design which is in the inverse of the decorative border to be bonded to the mirror surface and bordered by grooves which extend around the entire periphery of the decorative design, the mixture of silicone and catalyst being exposed to a vacuum before pouring to remove trapped air therefrom.

The invention will now be described, by way of example only, with reference to the accompanying diagrammatic drawings in which:

Figure 1 is a perspective view of a decorative window or mirror constructed in accordance with a preferred embodiment of the invention;

Figure 2 is a cross-sectional view of a master substrate from which a decorative window or mirror in accordance with the invention is produced;

Figure 3 is a cross-sectional view of a flexible mould from which replicas of the master substrate shown in Figure 2 are produced; and

Figure 4 is a section taken through apparatus by which a partially coloured resin sheet can be produced using the mould shown in Figure 3.

Figure 1 illustrates a decorative window or mirror 1 constructed in accordance with a preferred embodiment of the present invention. For ease of description the term "window" will be adopted in place of the expression "window or mirror". Thus, for the purposes of the following the word "mirror" is embraced by the word "window". The decorative window comprises a glass sheet 2 to which is laminated a resin sheet 3 using a suitable resin. The laminating resin is preferably a polyester resin or another adhesive such as polyvinyl butyral. The resin sheet 3 defines a decorative design 5 including coloured sections 6, and a non-decorative region 7. The exposed surface of the window may be coated with material which dries to form a relatively hardened durable surface. The coating may, for example, be a polyester, acrylic, polyurethane, urethane or silicone based material.

Figure 2 illustrates a master substrate 8 used to produce a flexible mould having a generally rubber-like consistency from which the resin sheet 3 is produced. The master substrate may be produced from cast acrylic or glass; other suitable materials may however be used. The surface of the master substrate 8 is formed with a decorative design 9 which corresponds to the decorative design 5 shown in Figure 1. In this preferred embodiment,

parts of the design are to be coloured. Preferably, the required design is produced by use of a suitably programmed computerised numerically controlled (CNC) machine tool. The use of a CNC machine tool enables a wide variety of different designs to be produced both accurately and relatively speedily. In a preferred embodiment, the master substrate is formed to reproduce the look of a traditionally fused, stamped or kiln-formed glass. The produced glass sheet is then bonded to a ridged substrate of wood, glass or metal.

A framework 10 of plastics or like material is applied to the substrate to provide increased thickness to contain the mould during its production.

The master substrate is also formed with shallow grooves 11 which extend around the margins of the decorative design 9 of the resin sheet. These grooves extend around the entire periphery of the design. Additional grooves may be provided, these being spaced inwardly from the groove.

To prepare the master substrate for producing a mould, any untextured portions of the substrate surface are polished to a high gloss and waxed using a wax product such as a paste. One or more surfaces of the master substrate may be textured to diffuse surface inhibitions following production of the mirror. Textures may be introduced by use of, for example, self-adhesive embossed sheets or surface treatments such as acid wash and plasters. The exposed surface of the master substrate is finally polished and coated with a release agent.

To produce the flexible mould, the cavity 14 of the master substrate 8 defined between the framework 11 is filled with a mixture which typically comprises a silicone and a catalyst blended with a pre-mixed substance consisting of a light oil additive mixed with a fast curing tin catalyst. The use of a catalyst in the mixture tends to introduce large amounts of air during the curing process. Consequently small indentations may be formed in the surface of the finished mould. To overcome this problem, the mixture is exposed to a vacuum of around 25Hg for a period of time (typically five minutes) before pouring. Any trapped air is thereby removed from the mixture. Use of the release agent ensures that silicone from the mixture is not left on the surface of the master substrate when the mould

is removed. Polishing of the master substrate surface ensures a clean and gloss-like finish to this mould surface.

The mixture is poured from a container to an intermediate level within the cavity 14 of the master substrate and a web or mesh is placed on the mixture surface to provide enhanced strength to the mould once it has cured. The web inhibits stretching of the mould when in use. Additional mixture is then poured over the web or mesh to the height of the framework 10 forming an upper surface. The mould 12 is placed with its flat surface against a waxed sheet of toughened or tempered glass. This is to ensure that the mould releases without sticking from the glass sheet during the production process. The glass sheet is merely a support which provides rigidity for the mould.

The profile of a produced mould 12 is shown in Figure 3. This profile includes a mirror image of the required decorative pattern 9 and protruding ridges produced by the grooves 11. These ridges act as compressible gaskets to confine subsequently cast resin to the area of the pattern 9. This resin is therefore prevented by these gaskets from flowing onto what is to be the reflective surface or surfaces of the mirror.

Figure 4 illustrates the use of the mould 12 to produce the resin sheet 3. Once removed from the master substrate 8, the mould 12 is inverted and its flat surface placed against a support member leaving the decorative side of the mould 12 facing upwards.

It is at this stage that preparations for imparting colouring to certain sections of the pattern begin. Firstly, a sheet of toughened (preferably tempered) glass 15 has printed on one of its surfaces 16 areas of colour 17 using a silk screen technique and inks compatible with the resin from which the resin sheet is to be produced. Alternatively, coloured films may be applied to the required surfaces 16 of the glass. The printed or applied colours may be the same or may vary and the sizes of the areas 17 may be the same or may vary. Once printed or film applied, the surface 16 is cleaned using a specialist cleaner and then primed using an adherent chemical, for example an organosilane ester composite solution.

In a further alternative, sections of the glass to be coloured may be masked prior

to hand-painting or spraying.

The sheet of toughened glass 15 is then placed on top of the mould 12 with its coloured surface(s) facing the mould to define a frame-shaped cavity 19 which is subsequently filled with a cast liquid resin which cures to a high degree of hardness to ultimately produce the resin sheet. The toughened glass sheet, mould and support member are then secured together with releasable spring loaded clamps 20.

Alternatively, pigmented resin may be poured into discrete sections of the mould prior to casting of the remaining resin. This may be in addition to or as an alternative to the colour printing, colour filming, hand-painting or spraying techniques discussed above.

Alternatively, discrete sections of the mould may be colour coated prior to casting of the resin. This may be in addition to or as an alternative to the techniques discussed above.

The mould 12 is cleaned using compressed air to remove any dirt or other contaminants before it is covered by the toughened glass sheet 15. The sheet 15 is carefully aligned over the mould to ensure that the coloured areas 17 are correctly positioned over those contours of the pattern 9 which are to be coloured.

For filling, a thin tube connected to a pump is inserted between the mould and the toughened glass sheet 15 to fill the cavity with liquid resin. To avoid distortion of the mould caused by pressure applied to it by the clamps, a small opening is made through the mould wall through which the tube is inserted.

A breather tube may be inserted into the cavity through a small opening formed in the mould at a position diagonally opposite to the opening through which resin is admitted to the cavity through the filling tube. During the filling process, the clamped assembly is supported on stops whereby the assembly is inclined at an angle with the breather tube at the upper corner of the mould. This ensures that any trapped air rises and is expelled through the breather tube during the casting process.

To prevent pin pricks in the surface of the cast resin caused by a micro layer of resin not curing because of incompatibility between the adjoining surfaces of the mould and the resin, heat is applied to the assembly during the casting and curing processes.

Preferably, the resin is a clear casting resin which consists primarily of a clear base resin blended with a stabilizer. The stabilizer is necessary to prevent the hardened resin sheet from turning yellow over time. In addition, the stabilizer beneficially inhibits the transmission of ultraviolet light.

Once the cavity is filled completely with liquid resin, the assembly of the spring clamps, annealed glass sheet, mould and support member is levelled for curing.

The sealed liquid resin is cured using a heating process either by exposing the assembly to infrared heat or by using an oven process. Infrared curing typically takes between seven and ten minutes to complete. Once cured, the spring clamps and the mould are removed to reveal the toughened glass sheet to which is bonded the resin sheet having the required decorative pattern and coloured sections corresponding to those of master substrate.

The toughened sheet of glass with the bonded decorative border may then be covered by a sheet of anti-reflective glass. Typically, the sheet of anti-reflective glass is supported on spacers to define a sealed air space. The anti-reflective surface of the sheet 1 may be sputter, cathodic or spray coated to produce a reflective index to 0.5% or below. Suitable spacers include those marketed by Edgetech under the name SUPER-SPACER (™).

It will be appreciated that the foregoing is merely exemplary of decorative mirrors and methods of producing such mirrors in accordance with the invention and that modifications can readily be made thereto without departing from the true scope of the invention.

CLAIMS

1. A decorative window or mirror which comprises a toughened glass sheet having on one surface one or more areas of colour and to which is bonded one or more sheets formed with a decorative pattern and produced from a cast resin, the or each area of colour overlying the or each resin sheet.

2. A window or mirror as claimed in claim 1 wherein the areas of colour are printed by silk screening one or more coloured inks onto the glass surface.

3. A window or mirror as claimed in claim 1 wherein the areas of colour comprise coloured films applied to a surface or surfaces of the glass sheet.

4. A window or mirror as claimed in claim 1 wherein the areas of colour are applied to the glass sheet by a hand-painting or spraying technique.

5. A window or mirror as claimed in any one of claims 1 to 4 in which the cast resin is transparent.

6. A window or mirror as claimed in any one of claims 1 to 4 in which the cast resin is tinted or coloured.

7. A window or mirror as claimed in any one of claims 1 to 6 wherein the resin is an acrylic.

8. A method of producing a window or mirror having a decorative pattern formed by casting liquid resin into a cavity defined between a toughened glass sheet whose surface has applied to it an area of colour, and a flexible mould which replicates the shape, dimensions and design of the required pattern, the mould having one or more upstanding gaskets which are positioned alongside the margin of the pattern to be formed and cooperate with the glass sheet to confine cast resin to the pattern area defined between the gasket(s), the coloured area of the glass surface being

positioned below the area confined by the mould.

9. A method as claimed in claim 8 wherein the flexible mould is produced by pouring a mixture of a silicone and a catalyst onto the surface of a substrate formed with a decorative design which is in the inverse of the decorative pattern to be bonded to the mirror surface and bordered by grooves which extend around the entire periphery of the decorative pattern, the mixture of silicone and catalyst being exposed to a vacuum before pouring to remove trapped air therefrom.

10. A method as claimed in claim 9 wherein a release agent is applied to the substrate surface before pouring of the silicone and catalyst mix.

11. A method as claimed in claim 9 or claim 10 wherein a web is placed on the surface of a first poured quantity of silicone and catalyst mix, the web being subsequently covered by a second pouring of the mix.

12. A method as claimed in any one of claims 8 to 11 further comprising the steps of releasing the mould from the substrate, inverting the mould, clamping to the upper surface of the mould a toughened glass sheet to which the pattern is to be bonded with the now upstanding ridge formed by the grooves of the substrate compressed to define the gasket(s) to prevent the outflow of liquid from the mould interior, casting into the mould interior liquid resin, and after curing of the resin, removing the flexible mould from the glass surface.

13. A method as claimed in claim 12 wherein means are provided in communication with the mould interior to release any trapped air therefrom.

14. A method as claimed in claim 12 or claim 13 wherein the liquid resin is cured by exposing the assembly of the glass sheet and the mould to infra-red heat.

15. A method of producing a mirror having a decorative border formed by casting liquid resin into a cavity defined between an annealed glass sheet and a flexible

mould which replicates the shape, dimensions and design of the required border, the mould having one or more upstanding gaskets which are positioned alongside the margin of the border to be formed and cooperate with the glass sheet to confine cast resin to the border area defined between the gasket(s).

16. A method as claimed in claim 15 wherein the flexible mould is produced by pouring a mixture of silicone and a catalyst onto the surface of a substrate formed with a decorative design which is in the inverse of the decorative border to be bonded to the mirror surface and bordered by grooves which extend around the entire periphery of the decorative design, the mixture of silicone and catalyst being exposed to a vacuum before pouring to remove trapped air therefrom.

17. A method as claimed in claim 16 wherein a release agent is applied to substrate surface before pouring of the silicone and catalyst mix.

18. A method as claimed in Claim 16 or claim 17 wherein a web is placed on the surface of a first poured quantity of silicone and catalyst mix, the web being subsequently covered by a second pouring of the mix.

19. A method as claimed in any one of claims 15 to 18 further comprising the steps of releasing the mould from the substrate, inverting the mould, clamping to the upper surface of the mould an annealed glass sheet to which the border is to be bonded with the now upstanding ridge formed by the grooves of the substrate compressed to define the gasket(s) to prevent the outflow of liquid from the mould interior, casting into the mould interior liquid resin, and after curing of the resin, removing the flexible mould from the glass surface.

20. A method as claimed in claim 19 wherein means are provided in communication with the mould interior to release any trapped air therefrom.

21. A method as claimed in claim 19 or claim 20 wherein the liquid resin is cured by exposing the assembly of the glass sheet and the mould to infra-red heat.

22. A window or mirror substantially as herein described and as described with reference to Figures 1 to 8 of the accompanying drawings.

23. A method for producing a window or mirror having a decorative pattern substantially as herein described and as described with reference to the accompanying diagrammatic drawings.

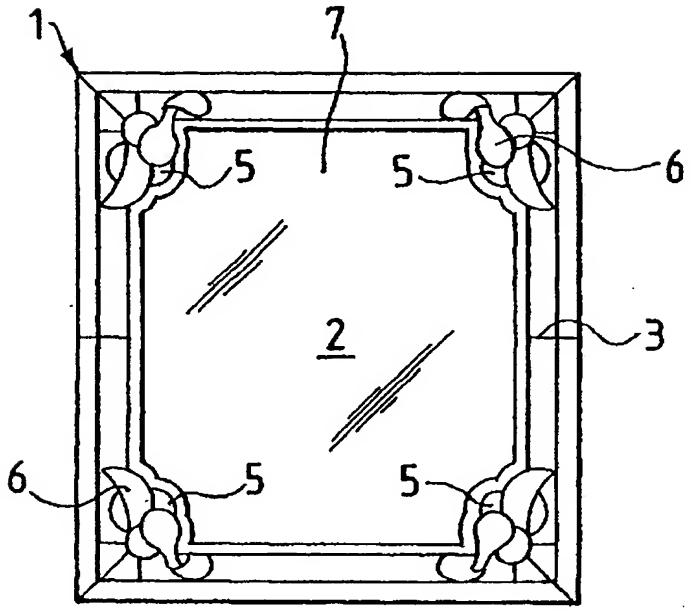

FIG.1.

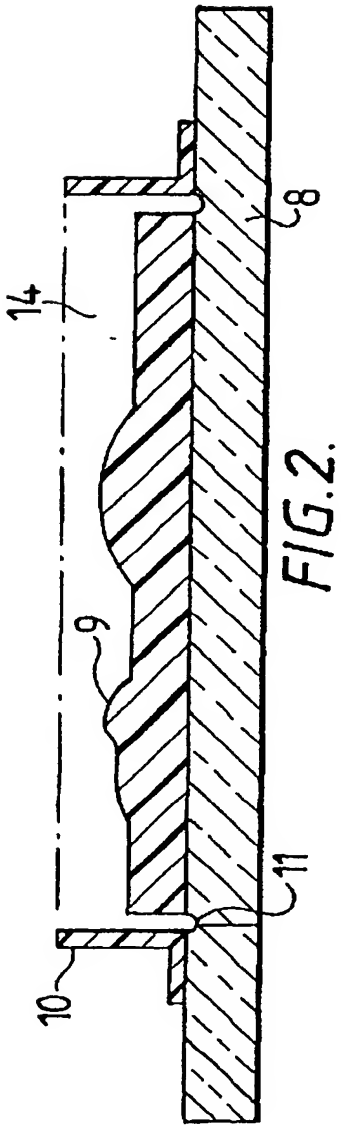

FIG.2.

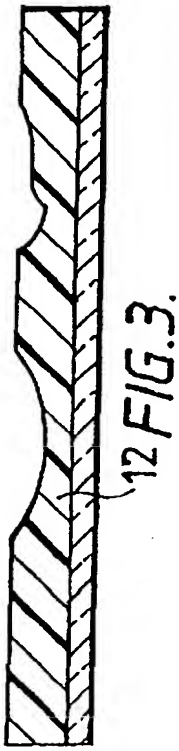

FIG.3.

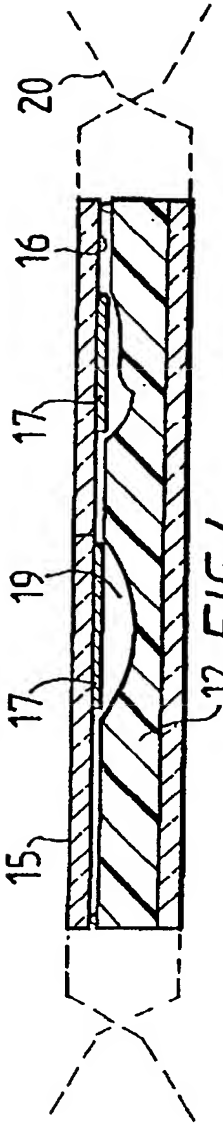

FIG.4.

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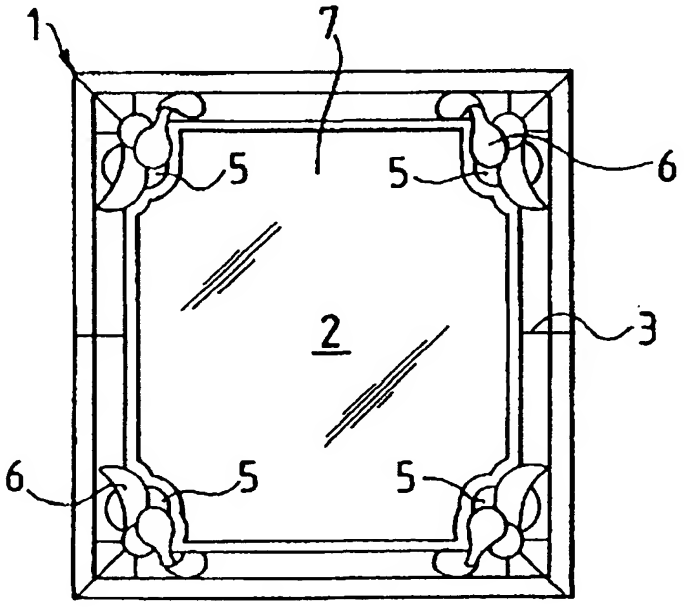

(57) Abstract: A decorative window and/or mirror comprises a toughened glass sheet having on one surface one or more areas a pattern or patterns which may be coloured. A sheet of resin material formed with a decorative pattern is bonded to the glass sheet. If the pattern is coloured, the areas of colour are positioned above those sections of the resin which are to appear coloured in the window or mirror.

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UK Patent Application 2338681A discloses a method of producing a decorative window which overcomes many of the problems discussed above. In this process a glass master containing a decorative pattern is used to fabricate a mould with a complementary

pattern. The mould is then oriented against a glass sheet having a release material facing the mould cavity. Hard casting resin is introduced into the cavity and cured. The decorative resin sheet can easily be removed from the mould and used to fabricate a window. The resin sheet can be cut to a desired size and shape. The cured decorative resin sheet is typically laminated to a glass sheet using a soft resin thus forming a decorative window. A second glass sheet may be attached to the decorative window in such a way as to house the resin sheet thus forming a window having an exterior consisting entirely of glass.

In many respects the present invention replicates the manufacturing process disclosed in GB-A-2338681. Modifications do, however, need to be made to the process disclosed particularly to ensure that the unpatterned area of the window or mirror remains at all times free of the resin which is used for producing the decorative pattern. These modifications are the subject of this invention and do provide a process by which windows and mirrors with decorative patterns can be produced relatively cheaply and with sufficient flexibility to enable a wide variety of aesthetically pleasing designs to be produced.

In one aspect, the invention provides a method of producing a window or mirror having a decorative pattern wherein resin is cast into a cavity defined between an annealed glass sheet and a flexible mould which replicates the shape, dimensions and design of the required pattern, the moulding having upstanding gaskets which are positioned alongside such margin of the pattern and cooperate with the glass sheet to confine cast resin to the pattern area defined between the gaskets.

The introduction of colours into decorative windows and mirrors has proved to be both difficult to achieve and expensive to produce. In many instances, this has previously been achieved by colouring discrete sections of the glass before or after curing, or by adhering coloured shapes to the finished window or mirror.

In another aspect, the present invention sets out to provide a decorative and at least partially coloured window and/or mirror which can be produced relatively cheaply and with sufficient flexibility to enable a wide variety of aesthetically pleasing patterns and

designs to be produced.

According to the present invention in this other aspect, there is provided a decorative window or mirror which comprises a toughened glass sheet having on one surface one or more areas of colour and to which is bonded one or more sheets formed with a decorative pattern and produced from a cast resin, the or each area of colour overlying the or each sheet.

The areas of colour may be printed by silk screening one or more coloured inks onto the glass surface. Alternatively, the areas of colour comprise coloured films applied to a surface or surfaces of the glass sheet. Alternatively, the areas of colour are applied to the glass sheet by a hand-painting or spraying technique.

The cast resin may be transparent. Alternatively, the resin may be tinted or coloured. Typically the resin is an acrylic.

In a further aspect, the invention provides a method of producing a window or mirror having a decorative pattern formed by casting liquid resin into a cavity defined between a toughened glass sheet whose surface has applied to it an area of colour, and a flexible mould which replicates the shape, dimensions and design of the required pattern, the mould having one or more upstanding gaskets which are positioned alongside the margin of the pattern to be formed and cooperate with the glass sheet to confine cast resin to the pattern area defined between the gasket(s), the coloured area of the glass surface being positioned below the area confined by the mould.

The flexible mould may be produced by pouring a mixture of a silicone and a catalyst onto the surface of a substrate formed with a decorative design which is in the inverse of the decorative pattern to be bonded to the mirror surface and bordered by grooves which extend around the entire periphery of the decorative pattern, the mixture of silicone and catalyst being exposed to a vacuum before pouring to remove trapped air therefrom.

A release agent may be applied to the substrate surface before pouring of the silicone and catalyst mix.

A web may be placed on the surface of a first poured quantity of silicone and catalyst mix, the web being subsequently covered by a second pouring of the mix.

The method may comprise the further steps of releasing the mould from the substrate, inverting the mould, clamping to the upper surface of the mould a toughened glass sheet to which the pattern is to be bonded with the now upstanding ridge formed by the grooves of the substrate compressed to define the gasket(s) to prevent the outflow of liquid from the mould interior, casting into the mould interior liquid resin, and after curing of the resin, removing the flexible mould from the glass surface.

Means may be provided in communication with the mould interior to release any trapped air therefrom.

The liquid resin may be cured by exposing the assembly of the glass sheet and the mould to infra-red heat.

In a still further aspect, the invention provides a method of producing a mirror having a decorative border formed by casting liquid resin into a cavity defined between an annealed glass sheet and a flexible mould which replicates the shape, dimensions and design of the required border, the mould having one or more upstanding gaskets which are positioned alongside the margin of the border to be formed and cooperate with the glass sheet to confine cast resin to the border area defined between the gasket(s).

The flexible mould may be produced by pouring a mixture of silicone and a catalyst onto the surface of a substrate formed with a decorative design which is in the inverse of the decorative border to be bonded to the mirror surface and bordered by grooves which extend around the entire periphery of the decorative design, the mixture of silicone and catalyst being exposed to a vacuum before pouring to remove trapped air therefrom.

The invention will now be described, by way of example only, with reference to the accompanying diagrammatic drawings in which:

Figure 1 is a perspective view of a decorative window or mirror constructed in accordance with a preferred embodiment of the invention;

Figure 2 is a cross-sectional view of a master substrate from which a decorative window or mirror in accordance with the invention is produced;

Figure 3 is a cross-sectional view of a flexible mould from which replicas of the master substrate shown in Figure 2 are produced; and

Figure 4 is a section taken through apparatus by which a partially coloured resin sheet can be produced using the mould shown in Figure 3.

Figure 1 illustrates a decorative window or mirror 1 constructed in accordance with a preferred embodiment of the present invention. For ease of description the term "window" will be adopted in place of the expression "window or mirror". Thus, for the purposes of the following the word "mirror" is embraced by the word "window". The decorative window comprises a glass sheet 2 to which is laminated a resin sheet 3 using a suitable resin. The laminating resin is preferably a polyester resin or another adhesive such as polyvinyl butyral. The resin sheet 3 defines a decorative design 5 including coloured sections 6, and a non-decorative region 7. The exposed surface of the window may be coated with material which dries to form a relatively hardened durable surface. The coating may, for example, be a polyester, acrylic, polyurethane, urethane or silicone based material.

Figure 2 illustrates a master substrate 8 used to produce a flexible mould having a generally rubber-like consistency from which the resin sheet 3 is produced. The master substrate may be produced from cast acrylic or glass; other suitable materials may however be used. The surface of the master substrate 8 is formed with a decorative design 9 which corresponds to the decorative design 5 shown in Figure 1. In this preferred embodiment,

parts of the design are to be coloured. Preferably, the required design is produced by use of a suitably programmed computerised numerically controlled (CNC) machine tool. The use of a CNC machine tool enables a wide variety of different designs to be produced both accurately and relatively speedily. In a preferred embodiment, the master substrate is formed to reproduce the look of a traditionally fused, stamped or kiln-formed glass. The produced glass sheet is then bonded to a ridged substrate of wood, glass or metal.

A framework 10 of plastics or like material is applied to the substrate to provide increased thickness to contain the mould during its production.

The master substrate is also formed with shallow grooves 11 which extend around the margins of the decorative design 9 of the resin sheet. These grooves extend around the entire periphery of the design. Additional grooves may be provided, these being spaced inwardly from the groove.

To prepare the master substrate for producing a mould, any untextured portions of the substrate surface are polished to a high gloss and waxed using a wax product such as a paste. One or more surfaces of the master substrate may be textured to diffuse surface inhibitions following production of the mirror. Textures may be introduced by use of, for example, self-adhesive embossed sheets or surface treatments such as acid wash and plasters. The exposed surface of the master substrate is finally polished and coated with a release agent.

To produce the flexible mould, the cavity 14 of the master substrate 8 defined between the framework 11 is filled with a mixture which typically comprises a silicone and a catalyst blended with a pre-mixed substance consisting of a light oil additive mixed with a fast curing tin catalyst. The use of a catalyst in the mixture tends to introduce large amounts of air during the curing process. Consequently small indentations may be formed in the surface of the finished mould. To overcome this problem, the mixture is exposed to a vacuum of around 25Hg for a period of time (typically five minutes) before pouring. Any trapped air is thereby removed from the mixture. Use of the release agent ensures that silicone from the mixture is not left on the surface of the master substrate when the mould

is removed. Polishing of the master substrate surface ensures a clean and gloss-like finish to this mould surface.

The mixture is poured from a container to an intermediate level within the cavity 14 of the master substrate and a web or mesh is placed on the mixture surface to provide enhanced strength to the mould once it has cured. The web inhibits stretching of the mould when in use. Additional mixture is then poured over the web or mesh to the height of the framework 10 forming an upper surface. The mould 12 is placed with its flat surface against a waxed sheet of toughened or tempered glass. This is to ensure that the mould releases without sticking from the glass sheet during the production process. The glass sheet is merely a support which provides rigidity for the mould.

The profile of a produced mould 12 is shown in Figure 3. This profile includes a mirror image of the required decorative pattern 9 and protruding ridges produced by the grooves 11. These ridges act as compressible gaskets to confine subsequently cast resin to the area of the pattern 9. This resin is therefore prevented by these gaskets from flowing onto what is to be the reflective surface or surfaces of the mirror.

Figure 4 illustrates the use of the mould 12 to produce the resin sheet 3. Once removed from the master substrate 8, the mould 12 is inverted and its flat surface placed against a support member leaving the decorative side of the mould 12 facing upwards.

It is at this stage that preparations for imparting colouring to certain sections of the pattern begin. Firstly, a sheet of toughened (preferably tempered) glass 15 has printed on one of its surfaces 16 areas of colour 17 using a silk screen technique and inks compatible with the resin from which the resin sheet is to be produced. Alternatively, coloured films may be applied to the required surfaces 16 of the glass. The printed or applied colours may be the same or may vary and the sizes of the areas 17 may be the same or may vary. Once printed or film applied, the surface 16 is cleaned using a specialist cleaner and then primed using an adherent chemical, for example an organosilane ester composite solution.

In a further alternative, sections of the glass to be coloured may be masked prior

to hand-painting or spraying.

The sheet of toughened glass 15 is then placed on top of the mould 12 with its coloured surface(s) facing the mould to define a frame-shaped cavity 19 which is subsequently filled with a cast liquid resin which cures to a high degree of hardness to ultimately produce the resin sheet. The toughened glass sheet, mould and support member are then secured together with releasable spring loaded clamps 20.

Alternatively, pigmented resin may be poured into discrete sections of the mould prior to casting of the remaining resin. This may be in addition to or as an alternative to the colour printing, colour filming, hand-painting or spraying techniques discussed above.

Alternatively, discrete sections of the mould may be colour coated prior to casting of the resin. This may be in addition to or as an alternative to the techniques discussed above.

The mould 12 is cleaned using compressed air to remove any dirt or other contaminants before it is covered by the toughened glass sheet 15. The sheet 15 is carefully aligned over the mould to ensure that the coloured areas 17 are correctly positioned over those contours of the pattern 9 which are to be coloured.

For filling, a thin tube connected to a pump is inserted between the mould and the toughened glass sheet 15 to fill the cavity with liquid resin. To avoid distortion of the mould caused by pressure applied to it by the clamps, a small opening is made through the mould wall through which the tube is inserted.

A breather tube may be inserted into the cavity through a small opening formed in the mould at a position diagonally opposite to the opening through which resin is admitted to the cavity through the filling tube. During the filling process, the clamped assembly is supported on stops whereby the assembly is inclined at an angle with the breather tube at the upper corner of the mould. This ensures that any trapped air rises and is expelled through the breather tube during the casting process.

To prevent pin pricks in the surface of the cast resin caused by a micro layer of resin not curing because of incompatibility between the adjoining surfaces of the mould and the resin, heat is applied to the assembly during the casting and curing processes.

Preferably, the resin is a clear casting resin which consists primarily of a clear base resin blended with a stabilizer. The stabilizer is necessary to prevent the hardened resin sheet from turning yellow over time. In addition, the stabilizer beneficially inhibits the transmission of ultraviolet light.

Once the cavity is filled completely with liquid resin, the assembly of the spring clamps, annealed glass sheet, mould and support member is levelled for curing.

The sealed liquid resin is cured using a heating process either by exposing the assembly to infrared heat or by using an oven process. Infrared curing typically takes between seven and ten minutes to complete. Once cured, the spring clamps and the mould are removed to reveal the toughened glass sheet to which is bonded the resin sheet having the required decorative pattern and coloured sections corresponding to those of master substrate.

The toughened sheet of glass with the bonded decorative border may then be covered by a sheet of anti-reflective glass. Typically, the sheet of anti-reflective glass is supported on spacers to define a sealed air space. The anti-reflective surface of the sheet 1 may be sputter, cathodic or spray coated to produce a reflective index to 0.5% or below. Suitable spacers include those marketed by Edgetech under the name SUPER-SPACER (™).

It will be appreciated that the foregoing is merely exemplary of decorative mirrors and methods of producing such mirrors in accordance with the invention and that modifications can readily be made thereto without departing from the true scope of the invention.

CLAIMS

1. A decorative window or mirror which comprises a toughened glass sheet having on one surface one or more areas of colour and to which is bonded one or more sheets formed with a decorative pattern and produced from a cast resin, the or each area of colour overlying the or each resin sheet.

2. A window or mirror as claimed in claim 1 wherein the areas of colour are printed by silk screening one or more coloured inks onto the glass surface.

3. A window or mirror as claimed in claim 1 wherein the areas of colour comprise coloured films applied to a surface or surfaces of the glass sheet.

4. A window or mirror as claimed in claim 1 wherein the areas of colour are applied to the glass sheet by a hand-painting or spraying technique.

5. A window or mirror as claimed in any one of claims 1 to 4 in which the cast resin is transparent.

6. A window or mirror as claimed in any one of claims 1 to 4 in which the cast resin is tinted or coloured.

7. A window or mirror as claimed in any one of claims 1 to 6 wherein the resin is an acrylic.

8. A method of producing a window or mirror having a decorative pattern formed by casting liquid resin into a cavity defined between a toughened glass sheet whose surface has applied to it an area of colour, and a flexible mould which replicates the shape, dimensions and design of the required pattern, the mould having one or more upstanding gaskets which are positioned alongside the margin of the pattern to be formed and cooperate with the glass sheet to confine cast resin to the pattern area defined between the gasket(s), the coloured area of the glass surface being

positioned below the area confined by the mould.

9. A method as claimed in claim 8 wherein the flexible mould is produced by pouring a mixture of a silicone and a catalyst onto the surface of a substrate formed with a decorative design which is in the inverse of the decorative pattern to be bonded to the mirror surface and bordered by grooves which extend around the entire periphery of the decorative pattern, the mixture of silicone and catalyst being exposed to a vacuum before pouring to remove trapped air therefrom.

10. A method as claimed in claim 9 wherein a release agent is applied to the substrate surface before pouring of the silicone and catalyst mix.

11. A method as claimed in claim 9 or claim 10 wherein a web is placed on the surface of a first poured quantity of silicone and catalyst mix, the web being subsequently covered by a second pouring of the mix.

12. A method as claimed in any one of claims 8 to 11 further comprising the steps of releasing the mould from the substrate, inverting the mould, clamping to the upper surface of the mould a toughened glass sheet to which the pattern is to be bonded with the now upstanding ridge formed by the grooves of the substrate compressed to define the gasket(s) to prevent the outflow of liquid from the mould interior, casting into the mould interior liquid resin, and after curing of the resin, removing the flexible mould from the glass surface.

13. A method as claimed in claim 12 wherein means are provided in communication with the mould interior to release any trapped air therefrom.

14. A method as claimed in claim 12 or claim 13 wherein the liquid resin is cured by exposing the assembly of the glass sheet and the mould to infra-red heat.

15. A method of producing a mirror having a decorative border formed by casting liquid resin into a cavity defined between an annealed glass sheet and a flexible

mould which replicates the shape, dimensions and design of the required border, the mould having one or more upstanding gaskets which are positioned alongside the margin of the border to be formed and cooperate with the glass sheet to confine cast resin to the border area defined between the gasket(s).

16. A method as claimed in claim 15 wherein the flexible mould is produced by pouring a mixture of silicone and a catalyst onto the surface of a substrate formed with a decorative design which is in the inverse of the decorative border to be bonded to the mirror surface and bordered by grooves which extend around the entire periphery of the decorative design, the mixture of silicone and catalyst being exposed to a vacuum before pouring to remove trapped air therefrom.

17. A method as claimed in claim 16 wherein a release agent is applied to substrate surface before pouring of the silicone and catalyst mix.

18. A method as claimed in Claim 16 or claim 17 wherein a web is placed on the surface of a first poured quantity of silicone and catalyst mix, the web being subsequently covered by a second pouring of the mix.

19. A method as claimed in any one of claims 15 to 18 further comprising the steps of releasing the mould from the substrate, inverting the mould, clamping to the upper surface of the mould an annealed glass sheet to which the border is to be bonded with the now upstanding ridge formed by the grooves of the substrate compressed to define the gasket(s) to prevent the outflow of liquid from the mould interior, casting into the mould interior liquid resin, and after curing of the resin, removing the flexible mould from the glass surface.

20. A method as claimed in claim 19 wherein means are provided in communication with the mould interior to release any trapped air therefrom.

21. A method as claimed in claim 19 or claim 20 wherein the liquid resin is cured by exposing the assembly of the glass sheet and the mould to infra-red heat.

22. A window or mirror substantially as herein described and as described with reference to Figures 1 to 8 of the accompanying drawings.

23. A method for producing a window or mirror having a decorative pattern substantially as herein described and as described with reference to the accompanying diagrammatic drawings.

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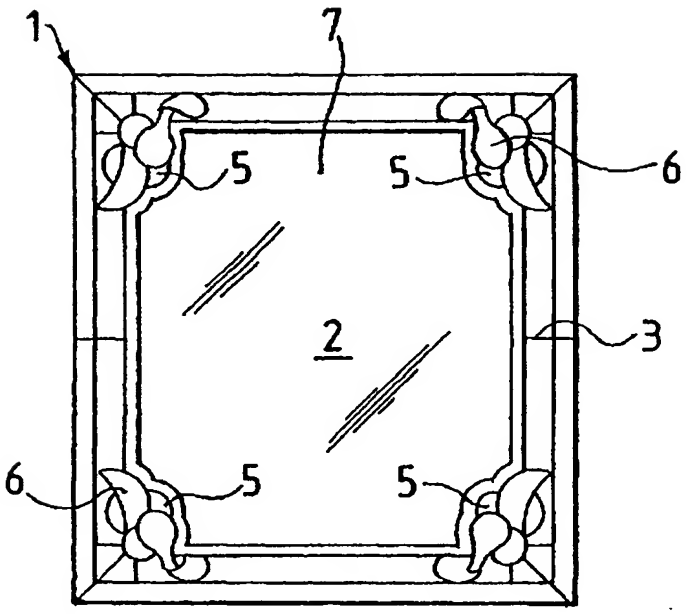

FIG.1.

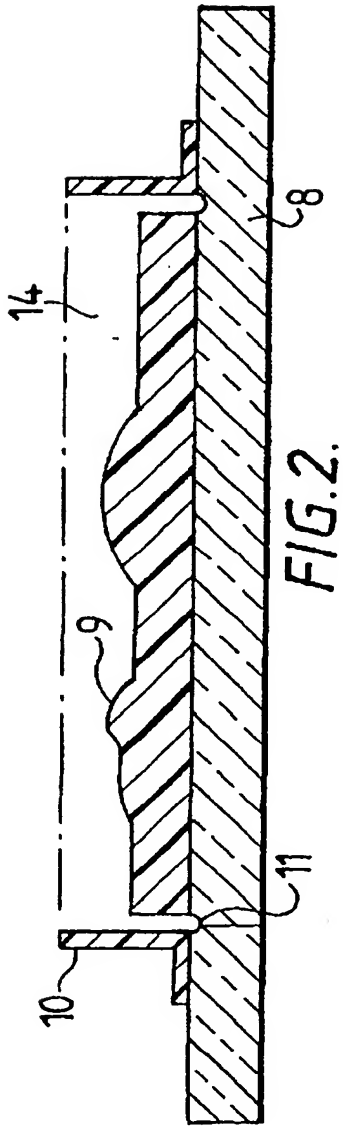

FIG.2.

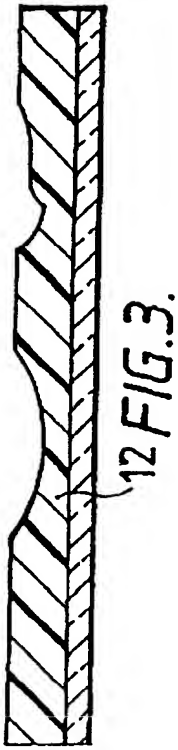

FIG.3.

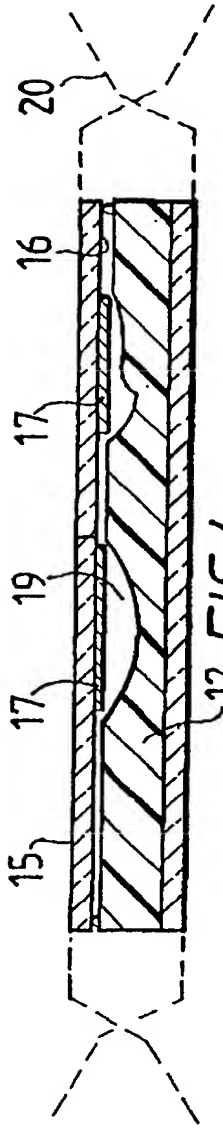

FIG.4.